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Cottonseed Handling With Small Air Pipes

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COTTON ginners, seedsmen, and farmers who seek an economical method for handling seeds, granular bulk materials, and various kinds of trash will find useful the small-pipe seed-handling system adapted to agricultural needs at the United States Cotton Ginning Laboratory, Stoneville, Miss. Two improved types of seed-pipe handling systems have been developed and tested at the laboratory: (1) A pressure, or "blow-through," method, utilizing 4- to 6-inch pipes with rotary air pumps and turboblowers; (2) a suction, or "draw-through," method, using 7- to 9-inch pipes with a high-speed, low-pressure cotton gin fan and a separator of special design. The first method has proved better adapted to long runs of piping and more economical and free from trouble, and it is advocated by the United States Department of Agriculture for pure-seed handling.

Small-pipe systems are unsurpassed in operating economy and freedom from trouble. They enable the cotton producer and ginner to preserve the purity of the cottonseed because the apparatus is self-cleaning. They have adequate capacity for removing 70 to 160 pounds of cottonseed per minute, as fast as the cotton is ginned. Being light in

[1] For suggestions and other assistance, acknowledgment is made to members of the staffs of the Cotton Branch, Production and Marketing Administration, and of the U. S. Cotton Ginning Laboratory, Bureau of Plant Industry, Soils, and Agricultural Engineering.

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weight, they can be moved about readily and should be a significant labor-saving means for quickly unloading trucks into railroad cars at inland trackage points and for emptying the cars at seed-breeders' treating and delinting plants. They may also be used for carrying the seed to storage bins and for moving it later for grading, sterilizing, and other processes at rates to suit the capacity of the plant. Cottonseed has been successfully handled by these small-pipe blowing systems for distances up to 700 feet, with approximately half the operating-power costs of larger pipe and fan methods.

The approved small-pipe system is shown in figure 1. A self-cleaning seed belt is used to feed the system dropper that introduces the seed into the air pipe, a tight valve enables the operator to divert the

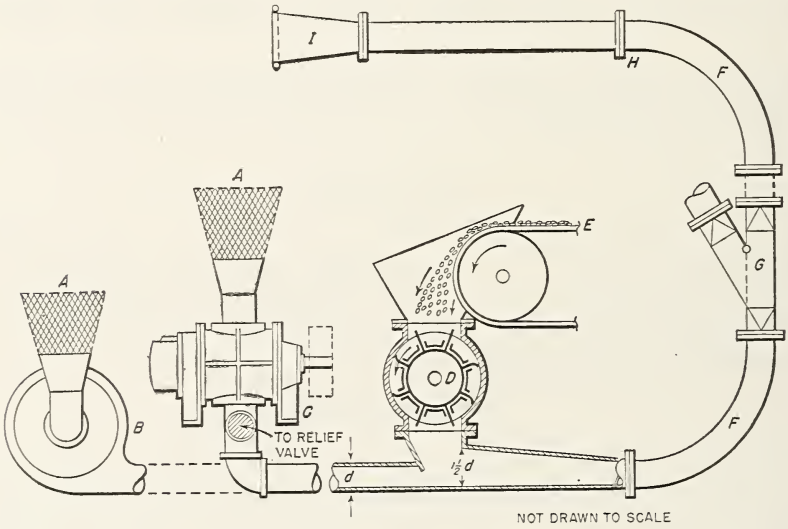

FIGURE 1.—Small-pipe piping system for cottonseed. *A*, 16-mesh air filter, or screen box; *B*, turboblower; *C*, rotary positive blower; *D*, dropper, or vacuum-wheel feeder with eight or more shallow pockets; *E*, gin-stand seed belt; *F*, long-sweep, 36-inch-radius elbows; *G*, valve for diverting seed to bin or storage; *H*, 6-bolt flange and rubber gasket; *I*, funnel discharge for efficiency of delivery. Diameter at *d*, 4 inches for one to three stands, and 5 inches for four to six.

seed to truck bin or to storage, and flanged piping and elbows provide the piping runs to points of delivery.

AIR-CONVEYING PRINCIPLES AND CALCULATIONS

Pipes of 4- and 5-inch diameter have proved large enough for handling cottonseed in the average gins and delinting plants. The 4-inch piping is sufficient for three-gin stands and for handling up to 3 tons of seed per hour. The 5-inch is recommended for stands of four or more gins and for handling up to 6 tons of seed per hour.

For preliminary calculations to determine the total resistance pressures that the pump or blower must overcome, it is customary to allow 16 ounces resistance (or 1 pound per square inch) for each 200 linear

feet of piping. In calculating, each short elbow and each valve must be considered equivalent to approximately 15 feet of straight pipe. For more accurate approximation, upon which the factory can provide the blower unit and suggest its speed, add up the pressure losses for the individual elements that make up the system as follows:

	Pressure allowance (ounces per sq. in.)
4-inch piping, each 100 feet	6
5-inch piping, each 100 feet	5
Elbow and valve, each	[1] 0.8
Base and tapered discharge from dropper	[1] 2
Cyclone collector and sacker at end of pipe	[1] 1

[1] For both 4- and 5-inch pipes.

This estimate is based on a velocity of 4,500 feet per minute, with volumes of 405 and 650 cubic feet per minute for 4- and 5-inch pipes, respectively.

Satisfactory mean or average air velocities within small seed pipes range from 4,200 to 5,200 feet per minute. Relatively small air volumes—about 4 cubic feet per pound of cottonseed [2]—have been satisfactory in short systems laid out by Department engineers, but it is advisable to allow 5 cubic feet where runs exceed 250 feet or where turboblowers are used. Since the velocity and volume of a conveying air stream depend on the average size and specific weight of the material, the above rules apply only to cottonseed.

For horizontal blowing of cottonseed the lower limit of air velocity in the pipe should be not less than 4,000 feet per minute, but any addition of elbows and risers necessitates an air speed increased to within the ranges given above. No seed should pass through the blowers, regardless of the kind of system.

Since air leakage is usually fatal to satisfactory operation of these systems, the joints should always be tight and the valves and feeders well-sealed.

BLOWERS AND AIR PUMPS

Existing practices at cotton gins include the general use of low-pressure air piping, ranging in diameter from 8 to 14 inches, operating with cotton-gin fans against 10 to 16 inches resistance pressure as measured on a U-tube water gage. In some instances the fans perform a suction service on seed cotton and then blow the seed with a dirty contaminated blast from the fan discharge. Such practices are not satisfactory and require approximately twice as much horsepower as small-pipe pure-seed systems, because 50 cubic feet of air per pound of seed are needed in comparison with 5.

Since operating air pressures for small-pipe systems usually vary from 1 to 3 pounds per square inch, it is necessary to use either slow-speed positive-pressure rotary air pumps or high-speed centrifugal turboblowers. Common fans cannot serve for this purpose. The rotary two-lobe air pump (fig. 2) is the type most commonly used and is known to the trade as a positive-pressure blower. Although the standard practice with liquids has been to place the suction intake on the under side and the discharge on the top side of the rotary

[2] For rotary positive-pressure blowers only.

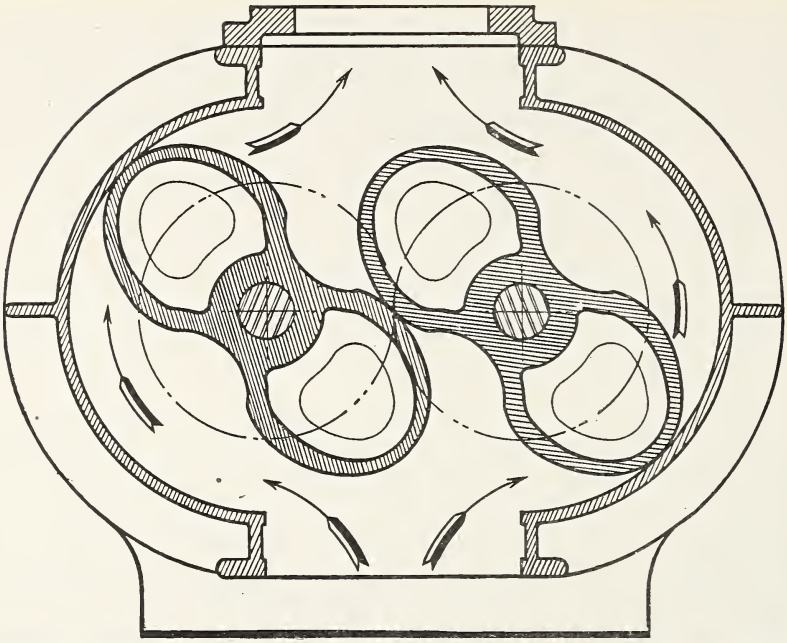

FIGURE 2.—Section through a typical positive-pressure two-lobe rotary air pump used for conveying cottonseed. Rotation may be reversed if desired.

pump, there are many advantages in reversing the method in seed handling. With the discharge underneath, dust and moisture are continually scavenged or expelled from the blower, thus lessening wear and damage.

Single-stage centrifugal turboblowers (fig. 3) that may be either belted or direct-connected and run at 3,500 revolutions per minute are used by various industries where the air pressures do not exceed 3 pounds per square inch. They weigh, with motor, 350 to 500 pounds, compared with 400 to 550 pounds for the bare rotary pump.

For stationary installations where unskilled labor may tend to feed cottonseed in lumps or where irregular and intermittent handling are involved, the Department recommends the use of the rotary positive-pressure blower because it can purge the piping to overcome minor chokages by a temporary build-up of sufficient air pressure. The choice of this type of air pump seems also to be advisable where the pipe runs are more than 200 feet in length.

For portable and short-run installations, the centrifugal turbo-blower unit can be used advantageously, and by means of temporary flexible connections it can be made to serve in numerous ways with profit.

Performance data are given in table 1 for blower size, seed-pipe diameter, air volume per minute, and operating horsepower, for the rotary positive-pressure blowers now being used successfully at cotton gins and seed establishments.

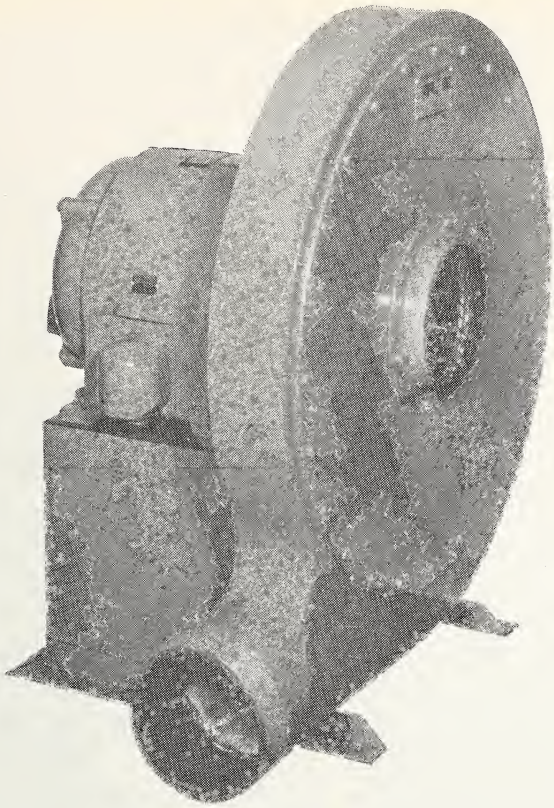

FIGURE 3.—Single-stage motor-driven centrifugal turboblower suitable for handling cottonseed. (Courtesy of the General Blower Company.)

TABLE 1.—*Performance data for rotary positive-pressure cottonseed blowers*

Stand and seed capacity	Size [1]	Pipe diameter	Speed	Pressure					
				1 pound [2]		2 pounds [2]		3 pounds [2]	
				Volume	Power	Volume	Power	Volume	Power
	No.	*Inches*	*R.p.m.*	*Cu. ft.*	*Hp.*	*Cu. ft.*	*Hp.*	*Cu. ft.*	*Hp.*
For gins up to 3 stands, and 70 to 90 pounds of seed per minute	615	4	575	325	2. 0	300	3. 8	280	5. 7
			615	350	2. 1	325	4. 1	310	6. 1
			690	400	2. 3	375	4. 6	360	7. 0
For 4 or more gin stands, and 130 to 160 pounds per minute, maximum	717	5	490	480	2. 8	450	5. 6	425	8. 5
			575	570	3. 2	540	6. 5	515	9. 7
			690	700	4. 0	670	8. 0	650	12. 0
			717	730	4. 1	690	8. 2	670	12. 3

[1] One of several trade designations.

[2] 4 cubic feet of air per pound of seed may be allowed at 1-pound pressure. At all higher pressures, allow 5 cubic feet.

Adapted from published tables of manufacturers.

Devices on Inlets and Outlets of Blowers

A screened intake, or air filter (fig. 4), is imperative on cottonseed-handling blowers to protect the lobes and casing from excessive wear and to prevent wisps of fiber and foreign matter from damaging and unbalancing high-speed blades. Screened-intake types of filters may be either factory-built or home-made. Large areas of close-mesh bronze screen wire are necessary for home-made intake filters, which should have at least 5 square feet of gross screen area, all accessible for daily or more frequent cleaning.

Positive-pressure blowers are usually provided with weighted relief valves on the discharge outlet. Therefore motor-driven units will not be overloaded by prolonged chokage or accidental high resistance. Relief valves and filters are both shown in figure 4.

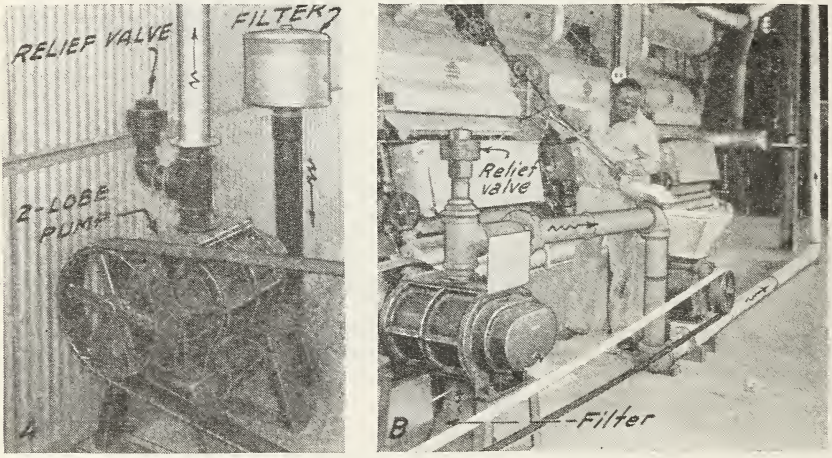

FIGURE 4.—Piping connection for positive-pressure blowers. *A*, With up-discharge pipe and raised filter; *B*, with filter directly beneath blower and discharge dropped to floor level. (For down-discharge on blower, see fig. 1.)

Centrifugal turboblowers are obtainable with a blast gate or butterfly type of control valve on the blower outlet, so that adjustment can be made to prevent overloading the motor. Since the outlet diameter of cottonseed turboblowers is usually 6 inches, the control valve becomes a necessary adjunct to the regulation of the 4- and 5-inch seed lines used at cotton gins, and it also is a desirable device for portable short-run installations.

Fitting a cheap small-diameter air-pressure gage on the outlet of all seed-handling blowers is recommended, so that the operators may be aware of excessive pressures and regulate their units more efficiently.

FEEDING SEED INTO PRESSURE PIPES

Cottonseed may be fed most satisfactorily into a small-pipe pressure system by means of a dropper, or rotary sealed wheel (sometimes called a vacuum wheel), that mechanically drops the seed into the air line on the discharge side of the pump or blower. Handling cottonseed by suction requires the use of a special separator, the expense of which is not warranted unless the rate approaches 40 tons or more per hour, in which case motors up to 75 horsepower and extremely large blowers are needed.

Speeds of the rotary sealed wheel, or dropper, should be relatively low—30 to 60 revolutions per minute—and internal seals at the ends and pocket divisions are necessary to prevent serious air leakage. A machined dropper (fig. 5) should handle up to 4½ tons of cottonseed

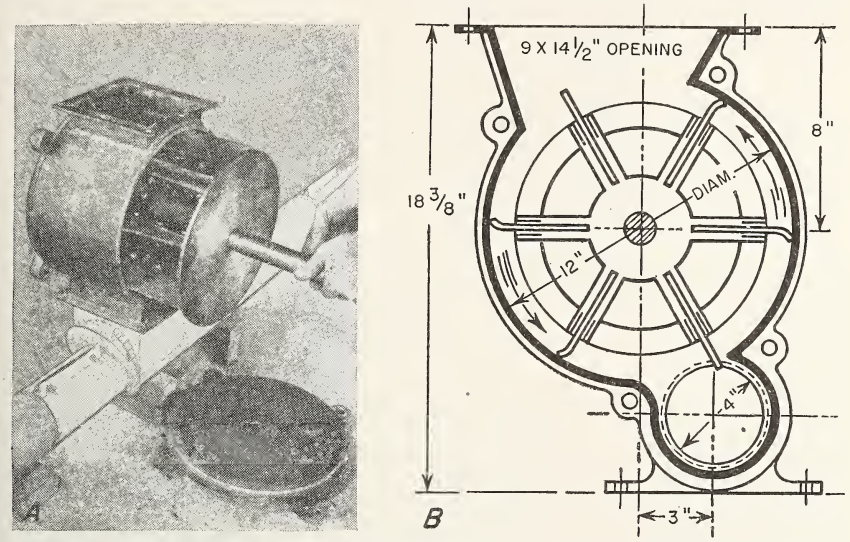

FIGURE 5.—Sealed-wheel droppers for handling cottonseed. *A*, Dropper that can be set either at right angles or parallel to seed pipe; *B*, section of dropper that can only be set parallel to pipe.

per hour at normal speed with 5-inch piping connections. It is customary to provide an independent drive for the dropper, because its speed is much slower than that of either a rotary positive blower or a centrifugal turboblower. A taper of 20 inches or more should be used on feeder base outlets or jet boxes to prevent chokage. Jet boxes must be set as close to the feeder as possible.

An alternative to the sealed-wheel dropper is the well-known seed-plug device, which utilizes a screw conveyor housed within a close-fitting tube. Although some satisfactory cottonseed-handling systems use this kind of feeder, generally the apparatus has not proved satisfactory. It is not recommended where a pure-seed system is called for, because the screw is difficult to clean out and should be filled with seed each time before starting.

PIPING

Piping may be 20-gage galvanized metal or heavier, with riveted and soldered seams for tightness and strength. The use of standard galvanized pipe or galvanized lightweight tubing is recommended where the piping is to be exposed to the weather.

Joints should be flanged wherever seed passes through the pipe. Six-bolt companion flanges with rubber gaskets are recommended. On the blower intake and discharge or at points ahead of the seed dropper, standard screwed pipe and fittings can be used for handling the compressed air.

Seed-handling elbows should be 18-gage or heavier and must be of the long sweep type to afford satisfactory service without chokage.

Elbows of 36-inch radius curvature are recommended for pipes of 4-, 5-, and 6-inch diameter.

Risers, or lifts, in seed piping should preferably be on an incline rather than on the vertical, to use minimum angles at elbows and to save the piping length that diagonals afford in comparison with right-angle runs.

Valves, Branches, and Discharges

Valves for small-pipe systems frequently give trouble in operation, especially where they are of inferior workmanship and poorly fitted for tightness. Not more than two valves should be used in the ordinary cottonseed system, because leakages and careless adjustments almost invariably invite trouble.

In the design of vane-type seed valves, the take-off angle should not exceed 30°, and the deflector vane, of adequate thickness, should be well fitted into the body of the valve, the seated end so adjusted that seed chokage will not be caused by lint or seed building up at the valve intake. Other types of satisfactory seed valves also are on the market.

Cyclone collectors of seed for delivery to sackers may be used at the ends of small-pipe systems. The downspouts from these collectors should be 8 inches or more in diameter to prevent choking or bridging of seed at the base of the collectors.

The discharge funnel, indicated at *I* in figure 1, is of material assistance to efficient air flow through the pipe to open bins, but it should not be aimed at a blank wall or at any object that might cause cracking of the seed.

OTHER FEATURES OF SMALL-PIPE SYSTEMS

Distances for conveying cottonseed with low- and medium-pressure systems—1 to 6 pounds pressure per square inch—are limited between approximately 200 and 700 feet of piping length. Since no two systems are quite alike in length and in number of risers and elbows, the limitation of pressure and volume incident to the type of blower must be carefully considered in the design of any small-pipe system.

Power cost is usually about half that of ordinary cotton-gin fan systems. Initial cost of small-pipe systems using positive-pressure blowers may range from $700 for a 250-foot pipe run and outside supports for overhead pipe to $950 for a 650-foot line. The cost of piping may be estimated at 50 cents per linear foot for the 4-inch diameter of galvanized 20-gage pipe in 12-foot lengths, and 60 cents for the 5-inch. Valves may cost up to $30 each; 90° elbows up to $10; feeders, $125; positive-pressure blowers without motor, $400; and motor-driven centrifugal turboblowers, $350 to $400. Labor costs vary, of course, depending on the locality.

A broad field of agricultural use awaits the small-pipe handling system when its power- and space-saving features are understood. Its efficiency depends on correct installation. Being portable, it is proving ideal for year-round use in unloading and loading between trucks, railroad cars, and storage houses.

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